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TIME DOMAIN REFLECTOMETERS

User Manual for HL-TDR™ Version 1.1.x

Applies to Model Numbers

HL1101, HL1202, HL1204

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Introduction

These consolidated reference materials apply to all Time Domain Reflectometer (TDR) instruments from HYPERLABS and the included HL-TDR™ software. Not all instruments have all of the features included below.

Please note that each model number includes its own HL-TDR™ software package which can be downloaded from our website. Software packages are not cross-compatible with other instruments.

For further technical support, please visit our website: www.hyperlabsinc.com

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Section 1: Instrument Setup

All HYPERLABS TDRs are self-contained instruments powered and controlled via a single USB port. The included HL-TDR™ software and drivers are compatible with all versions of Windows XP, Windows Vista, Windows 7, and Windows 8. At this time, there are no plans for OS X, Linux, or other operating system support.

The instrument should always be plugged into the PC prior to running the HL-TDR™ software.

NOTE: Model numbers HL1101, HL1202, and HL1204 are electrostatic-protected instruments, complaint with Class 2 of ESDS Component Sensitivity Classification (ESD STM5.1-1998). Static protection is not required to use these instruments in most applications.

Section 2: Driver and Software Installation

HYPERLABS TDRs utilize drivers from FTDI. On computers connected to the internet, the latest signed drivers will be automatically downloaded and installed as soon the instrument is plugged in to a working USB port.

If the computer is not connected to the internet or not configured for automatic driver installation, the FTDI drivers must be manually installed. Please visit the following page to download the latest version of the FTDI drivers: http://www.ftdichip.com/Drivers/D2XX.htm

If the program states it cannot find “FTD2xx.dll”, download the driver package at the address above, extract the .ZIP file, and copy the FTD2xx.dll file into the installation directory listed below.

Once the FTDI driver is installed, the HL-TDR™ software can be installed by running “setup.exe” in the included install package. If the package is in compressed (.zip) format, all files must be extracted prior to installation.

By default, the software will install to the following directory, where “HLxxxx” is the model number:

- For all versions of Windows: “C:\HYPERLABS\HLxxxx\”

During installation, the user may elect to install to a different directory. No other user options are available during the installation process.

Section 3: Software Startup

Each instrument model has its own build of the HL-TDR™ software, customized for that instrument’s speed and number of channels. The software packages are not cross-compatible with other models. The executable for each instrument will be the same as the instrument model number, e.g. “HL1101.exe” for the HL1101 model.

The instrument is calibrated at startup, a process that takes 5-10 seconds. The software will not be responsive to user input during that time and “***Calibration in Progress***” will be shown in the top-right corner. When calibration is complete, a “***Calibration Done***” message will appear.

If the installation was successful, the operator will see the user interface shown on the following page. If any error messages are shown, please make sure that the instrument is plugged in and the drivers installed (see *Sections 1-2* above) before contacting HYPERALBS for additional support.

NOTE: All HYPERLABS instruments include free lifetime software upgrades. The ***installed software version*** is shown in the top-left corner of the HL-TDR™ software, above the ***Scaling*** control. Please check our website regularly for updated versions which include the latest features described here.

Section 4: Overview of HL-TDR™ Software Controls

When the HL-TDR™ software is running, the user will see a screen similar to *Figure 1* below, which has been marked up to highlight the important software features and controls.

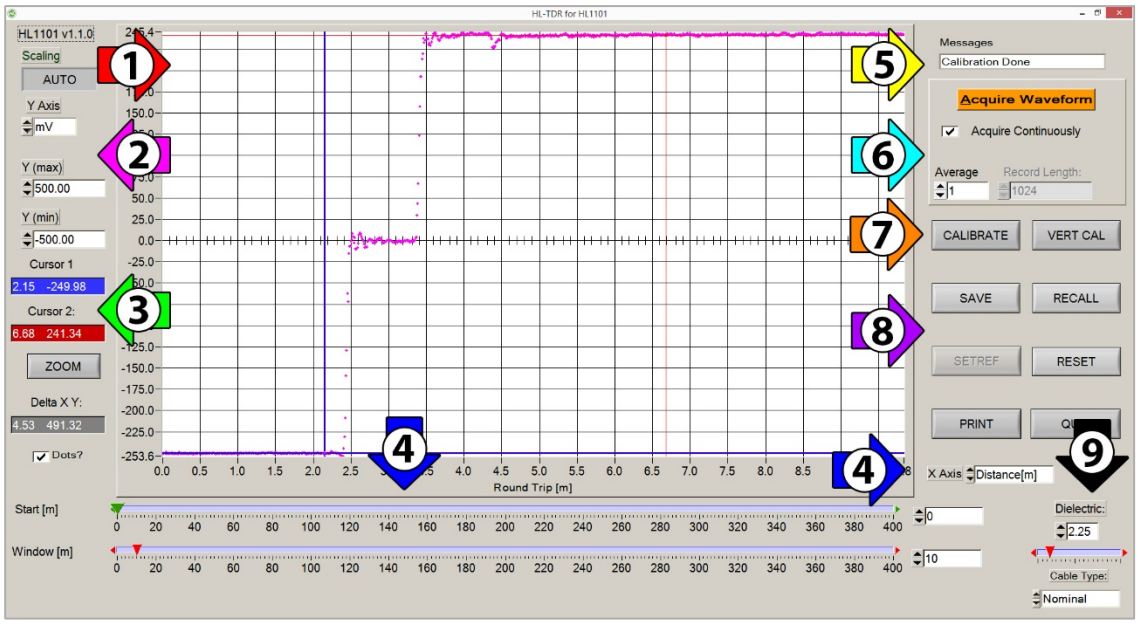

Figure 1: Startup Screen for HL-TDR™ for HL1101, with Important Features Labelled

Detailed descriptions of the highlighted features and controls can be found in the following Sections:

1. Waveform Display Area, *Section 6*
2. Vertical Scale and Unit Controls, *Section 5.1*
3. Cursor Position Readout, *Section 6.2*
4. Horizontal Scale and Unit Controls, *Section 5.2*
5. User Message Box, *Section 5.3*
6. Waveform Acquisition and Averaging, *Section 5.4*
7. Calibration Controls, *Section 6.4*
8. Waveform Storage and Comparison Controls, *Sections 6.6-6.7*
9. Dielectric Constant (K) Controls, *Section 5.5*

NOTE: Not all software features are available on all models. The interface will vary slightly based on the number of instrument channels of each model.

Section 5: Test Environment Setup

The HL-TDR™ software allows users to modify most environmental variables and create a test setup that fits their specific application needs. The Subsections below explains the available options for each control, and the most common situations in which they are useful.

For further help determining the ideal test setup for your application, please review the Application Guides on our website, or contact HYPERLABS.

Section 5.1: Vertical Scale and Units

The vertical scale and units of the HL-TDR™ software are controlled using the Y-axis Scale and Units options, shown in closer detail in *Figure 2* at right.

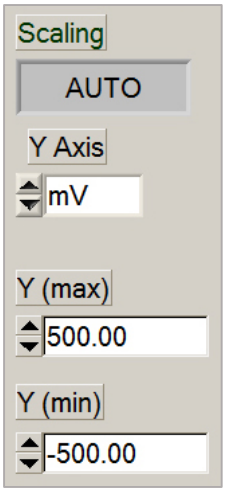

Figure 2: Close-up of Y-axis Scale and Units Controls

The ***Y Axis*** control changes the units displayed on the vertical axis of the Waveform Display Area.

Different vertical units provide different types of information about the device under test. For recommendations on which units to use in specific test environments, please reference *Figure 3* below or contact HYPERLABS.

The top button can be toggled between **AUTO**, which scales the vertical axis automatically based on the waveform values, and ***MANUAL***, which constrains the display based on the selected ***Y (max)*** and ***Y (min)*** values. Suggested values for ***Y (max)*** and ***Y (min)*** depend on the selected vertical unit, and can also be found in *Figure 3* below.

NOTE: When the software is in ***MANUAL*** mode, the ***Y (max)*** and ***Y (min)*** values do not automatically scale to the recommended values when the user switches units. This can cause the waveform to become unreadably large or small relative to the vertical scale. Be sure to readjust the ***Y (max)*** and ***Y (min)*** values once the desired unit is selected.

UNITS	Y (max)	(Ymin)	Description
mV (millivolts)	250	-250	Default setting, measures the voltage of the 250 mV pulse sent by the instrument
Normalized Voltage	2.0	0.0	Voltage represented as a fractional value, where 0 indicates no reflection, 1.0 indicates the full 250 mV is reflected, and 2.0 indicates an open
Impedance (Ω)	500	0.0	Impedance, in ohms (Ω), of the device under test
Reflection Coefficient (Rho)	1.0	-1.0	Coefficient of impedance, where 0.0 represents 50 Ω

Figure 3: Recommended Vertical Scale for Each Unit Type

Section 5.2: Horizontal Scale and Units

The horizontal scale of the Waveform Display Area is controlled using the ***Start*** and ***Window*** sliders found below and to the right the display area. Numerical values can also be inputted directly in the corresponding boxes located to the right of each slider.

The ***Start*** slider defines the beginning of the Waveform Display Area. The ***Window*** slider determines its width. Note that the maximum range of HYPERLABS TDRs is 200 m (400 m roundtrip).

There are three options for horizontal units:

- Distance (m) – Default setting, used to locate discontinuities in the device under test; requires the proper value for the dielectric constant (K, see *Section 5.5* for more information) to provide an accurate measurement of distance
- Distance (ft) – Alternate measure of distance; also requires accurate dielectric constant (K) value
- Time (ns) – Time, in nanoseconds

NOTE: All horizontal measurements indicate the round-trip distance or time of the reflection, i.e. the distance covered by the impulse reaching the end of the system and coming back, or the time it takes to do so. See our website for more information on how to correctly read distance and time measurements.

Section 5.3: User Message Box

In the top-right corner of the HL-TDR™ software is a small text box that provides messages about the status of the software and hardware. Currently, this is only used to indicate the calibration status of the instrument. If the instrument is working properly, it will read "***Calibration Done***". While the instrument is being calibrated, this will indicate "***Calibration in Progress***".

Section 5.4: Waveform Acquisition Modes and Averaging

By default, the HL-TDR™ software operates in continuous acquisition mode. In this mode, new waveforms are outputted to the Waveform Display Area as quickly as the instrument can acquire them.

Alternatively, the software can set to acquire and display a single waveform. In this mode, the operator must manually click the ***Acquire Waveform*** button to output a new waveform.

To switch between constant and manual acquisition, the ***Acquire Continuously*** checkbox can be toggled.

As of Version 1.1 of the HL-TDR™ software, waveform averaging is functional and can be controlled by adjusting the control.

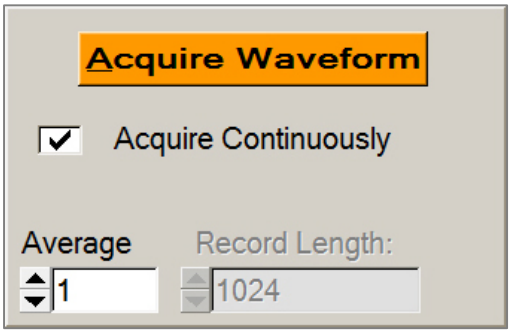

Figure 4: Waveform Acquisition Mode Controls, set to Continuous Acquisition

NOTE: Waveform averaging slows the software considerably. If more than 2 waveforms are averaged, we recommend manual waveform acquisition mode.

Also in Version 1.1, the default number of data points on the waveform (1024) is a locked variable and cannot be modified.

Section 5.5: Dielectric Constant (K) Controls

To obtain an accurate measure of distance when analyzing an electrical system, the correct dielectric constant (K) must be used. In particular, the different insulating materials used in various cable types affect the signal's velocity of propagation, which is used to calculate distance.

The Dielectric Constant Controls in the HL-TDR™ software are found in the right instrument panel and shown in detail in *Figure 5* at right.

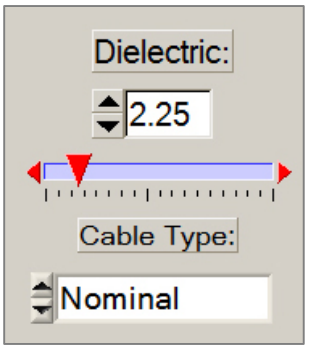

Figure 5: Dielectric Constant Controls, set to Nominal Type (K = 2.25) Insulation Type

K is a numerical value that can be changed by the user based on the material being tested. The box below allows the user to enter a number for the dielectric constant.

The ***Cable Type*** drop-down menu can also be used to switch between cable types.

A table of common dielectric constant values can be found in *Figure 6* below. To find the dielectric constant of other unusual materials, please contact HYPERLABS for assistance.

Material	**K**
Coaxial cable with polyethylene insulation (Nominal)	2.25
Coaxial cable with Teflon insulation	2.06
Printed Circuit Board (PCB)	4.0-4.3
Gallium Arsenide Integrated Circuits	13.1

Figure 6: Table of Dielectric Constants for Common Materials

Section 6: Waveform Display Area

The HL-TDR™ software presents data in both visual and numerical formats. The acquired waveform is displayed graphically in the main portion of the screen.

This User Manual does not cover tips for understanding and interpreting waveforms encountered in specific instrument applications. Given the variation of instruments, test environments, and outcomes, instruction in this area is provided in Application Guides found on our website: http://www.hyperlabsinc.com/application-guides.aspx

Section 6.1: Positioning the Cursors

A pair of cursors can be used to take numerical readings at any point along the waveform. These cursors are positioned via drag-and-drop, and automatically snap to the closest point on the waveform. Cursor 1 is blue, while Cursor 2 is red.

NOTE: Because the cursors automatically snap to the waveform, it may be difficult to position the cursors or obtain accurate values when the instrument is set to continuous acquisition mode. We recommend switching to manual acquisition mode (see *Section 5.4* above) prior to positioning the cursors.

Section 6.2: Horizontal and Vertical Cursor Values

Values for cursor positions are provided in the "X Y" format. In the example shown in *Figure 7*, ***Cursor 1*** is positioned at a position of X = 2.15 m and Y = -249.98 mV. ***Cursor 2*** is positioned at X = 6.68 m and Y = 241.34 mV.

Horizontal values are provided in the active horizontal unit, either distance (m), distance (ft), or time (ns). Note that the horizontal values will always be displayed in round-trip distance or time.

The vertical values are provided in the active vertical unit (see *Section 3.2* above).

In the ***Delta X Y*** box shown at right, the horizontal and vertical differences between the cursor are shown in the "X Y" format. In this example, the cursors are 4.53 m apart, and there is 491.32 mV difference between them.

Once positioned, each cursor also has a colored horizontal and vertical line to help the operator quickly locate them. These can be seen in *Figure 10* on the next page.

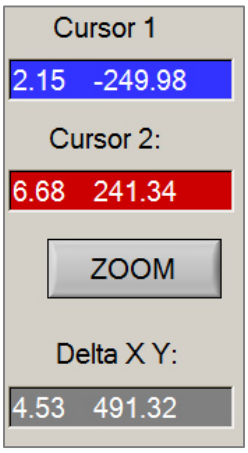

Figure 7: Cursor Position Controls

Section 6.3: Using the Cursors to Zoom

To quickly zoom in on a smaller portion of the waveform, the ***ZOOM*** button, shown in *Figure 7* above, can be used. This fits the horizontal scale of the Waveform Display Area to an area slightly wider than the position of the cursors.

Section 6.4: Calibration Controls

All HYPERLABS TDRs have auto-calibration features, and the instrument automatically calibrates on software startup. Manual calibration can be performed by clicking one of the buttons shown in *Figure 8* at right.

Figure 8: Calibration Controls

The ***CALIBRATE*** button performs a full instrument calibration including the vertical and time base calibration. This may take up to 10 seconds to complete and a confirmation message will be shown when it's done.

The ***VERT CAL*** button performs a simple vertical calibration based on the internal reference cable of the instrument. This calibration happens instantly, and no confirmation message is shown on completion.

Section 6.5: SETREF Functionality

The **SETREF** feature, shown in *Figure 9* below, is not currently available as of HL-TDR™ Version 1.1. This functionality will be added in the near future.

Section 6.6: Storing and Retrieving Waveforms

Individual waveforms can be stored for later reference, and retrieved using the panel shown in *Figure 9* at right.

Figure 9: Controls for Manipulating Waveforms

In applications where all devices are expected to conform to pre-defined specifications, each unit can be quickly compared against a known standard.

To store a waveform, follow these steps:

1. Connect the instrument to the device whose waveform you wish to store and acquire a waveform
2. Click the **SAVE** button
3. In the prompt that says "Enter File ID", enter a filename for the stored waveform

NOTE: Stored waveforms does not have a file extension and are saved to the program installation directory. The HL-TDR™ software does not currently allow the user to change the file location while saving.

To retrieve a previously-stored waveform, follow these steps:

1. Click the **RECALL** button
2. Navigate to the program installation directory (or other location where the waveforms have been saved), choose the file, and click **Select**
3. The stored waveform will be displayed in green with the black waveform of the current device under test

Section 6.7: Comparing Active Waveforms to Stored Waveforms

Figure 10 below shows a coax cable, in open, under test (magenta) compared against the stored waveform (green) of a cable with a short at the far-end connector. Note how these two waveforms are immediately discernable to the naked eye.

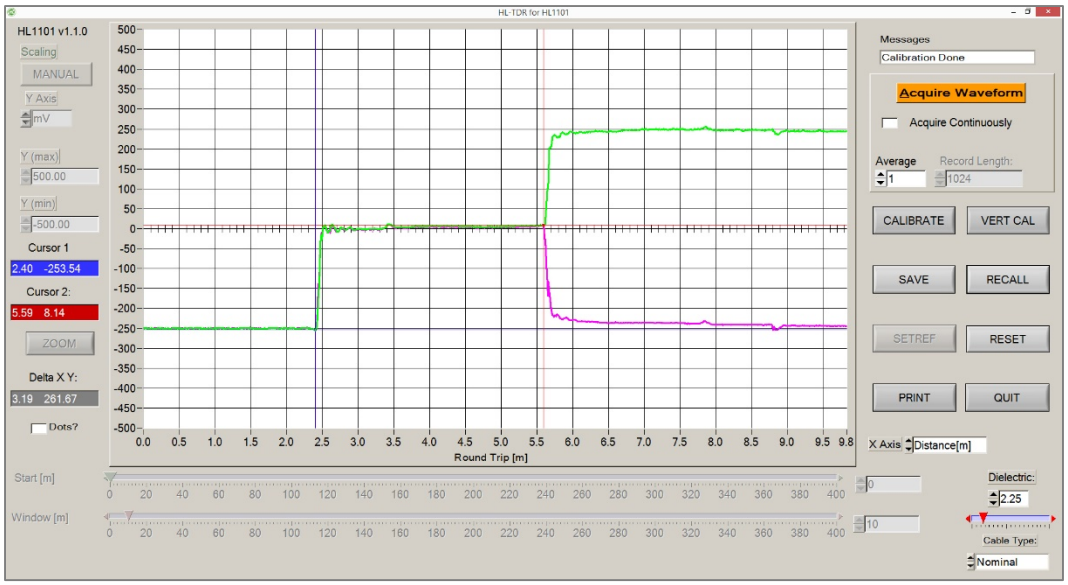

Figure 10: Stored Waveform, in Green, and Active Waveform, in Magenta

Section 7: Additional Resources

This manual for HYPERLABS Time Domain Reflectometer instruments is primarily intended to cover instrument setup and familiarize the user with the major features of the HL-TDR™ software. The applications for TDRs are too many and varied to cover fully in this User Manual.

Accordingly, we have made a wide variety of Application Guides and other reference materials on our website. A full listing of Application Guides can be found at: http://www.hyperlabsinc.com/application-guides.aspx

If help for your application isn't shown in our Application Guides, HYPERLABS is always happy to provide unlimited technical support to our customers. For up-to-date telephone or email support options, please see our webpage: http://www.hyperlabsinc.com/contact-us.aspx

Section 8: Copyright Information

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